03-02-00

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Docket No. 14XZ00060

UTILITY PATENT APPLICATION TRANSMITTAL

TO: Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 20231

Transmitted herewith for filing under 35 USC 111(a) and 37 CFR 1.53(b) and 35 USC 371 is a new ☒ utility ☐ design patent application for an invention entitled:

METHOD AND APPARATUS FOR CONTROL OF EXPOSURE IN RADIOLOGICAL IMAGING SYSTEMS

and invented by: Vladislav BOUTENKO and Remy KLAUSZ

If a continuation application:

☐ continuation ☐ division ☐ continuation-in-part of prior application Serial No.

Enclosed are:

1. ☒ Specification having seventeen pages (17) comprising the following:
   - a. ☒ Claims numbered from 1 to 35
   - b. ☒ Abstract of the Disclosure
   - c. ☒ Drawing (s) as follows:
     - (1) ☐ Formal ☒ Informal
     - (2) Number of Sheets – three (3) with Figures No. 1-5
   - d. ☒ Oath or Declaration as follows:
     - (1) ☐ Original and signed
     - (2) ☒ Unsigned
     - (3) ☐ Copy from prior application Serial No. filed
     - (4) ☒ With Power of Attorney
     - (5) ☐ Without Power of Attorney
2. ☐ Incorporation by Reference (if Box 1d(3) is checked)
3. ☐ Assignment
   - ☐ Recordation Cover Sheet
   - ☐ Document

4. ☐ Preliminary Amendment

5. ☒ Acknowledgment Postcard

6. ☒ Certificate of Mailing by "Express Mail"

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 as Express Mail No. EK552819911US on March /, 2000 and is addressed to the Assistant Commissioner for Patents, Box PATENT APPLICATION, Washington, DC 20231.

Dolores K Tillson

(Name and Date) Dolores K. Tillson, March /, 2000

7. ☒ Filing fee calculated and transmitted:

a. ☑ as described below for the claims as filed

			Small Entity		Large Entity	
For	No. Filed	No. Extra	Rate	Fee	Rate	Fee
Basic				$ 345		$ 690
Total Claims	35 - 20 =	-15-	X $ 9 =	$	x $ 18 =	$ 270
Ind. Claims	2 - 3 =	-0-	X $ 39 =	$	x $ 78 =	$
Mult. Dep. ☐			+$130 =	$	+ $260 =	$
Total Filing Fee				**$ 345**		**$ 960**

b. ☐ see attached PTO-1398 for Transmittal Letter to US Designated/Elected Office for National Stage of PCT

c. ☐ design filing fee of $310.00

d. ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. 09-0470 as described below. A duplicate copy of this sheet is enclosed.

(1) ☒ Charge the amount of ☐ $310.00 ☐ $690.00 ☒ 960.00 as filing fee.

(2) ☒ Credit any overpayment.

(3) ☒ Charge any additional filing fees required under 37 CFR 1.16 and 1.17.

(4) ☐ Charge the Issue Fee set in 37 CFR 1.18 at the mailing of the Notice of Allowance, pursuant to 37 CFR 1.311(b).

d. ☐ A check in the amount of $ to cover the filing fee is enclosed.

8. ☒ Information Disclosure Statement

a ☒ PTO-1449

b. ☒ Copies of Cited Documents

9. ☒ Certified Copy of Priority Document

Country	France
Filing Date	4 March 1999
Application No.	99 02711
Applicant	GE Medical Systems S.A.

10. ☐ Verified Statement to establish Small Entity status under 37 CFR 1.9 and 37 CFR 1.27

11. ☐ Additional Enclosures as follows:

a. ☐

b. ☐

Date: March /, 2000

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METHOD AND APPARATUS FOR CONTROL OF EXPOSURE IN RADIOLOGICAL IMAGING SYSTEMS

BACKGROUND OF THE INVENTION

The present invention concerns the field of radiological imaging. An object such as a human being or an animal or an object if a human being or animal to be studied under X-rays is placed between an X-ray source and a means of detection making possible a visualization of the X-ray beam after it crosses the object.

The control of radiological image exposure usually consists of keeping the brightness of the visible images constant. This principle is derived from the first constant sensitivity image receptors, notably, radiographic films for static images and fluorescent screens for fluoroscopy.

The known systems using indirect image receptors, based, for example, on image intensifiers, reproduce that behavior by having, for a given application, a fixed gain between the entrance exposure, also described as "entrance dose," and the brightness of the image displayed, by adjusting the gains of the radiology apparatus, such as the optical gain by means of a diaphragm placed in the optical path, or an electronic amplification, or by adjusting a digital gain coefficient. The only exception to this fixed gain is to be found in case the X-ray parameters reach their upper limits on radioscopy. In such case, the gain is increased in order to compensate for decrease of the signal. This method is generally known in video systems as automatic gain control.

The method used for brightness or dose control consists of using the signal supplied by a sensor, the signal being representative of the dose or brightness, and comparing it to a reference corresponding to the desired level. The result of that comparison is entered in a device controlling the parameters of the X-rays used to obtain the image (supply voltage of the tube, supply

current of the tube or product of the current by time), for the purpose of restoring the level desired.

It is of interest to observe what happens when the geometric enlargement is modified, that is, when either the object to be studied under X-rays, or the X-ray source or the image receptor is moved along the axis of the X-ray beam. By neglecting the diffusion effects of radiations, the brightness sensor will react exclusively to changes in distance between the source and the receptor, according to the inverse square of that distance.

If the distance is increased, the control loop will produce an increase in the X-ray parameters, and inverts it if the distance is reduced.

Now, this method can present problems. The distance between the X-ray source and the plane containing a significant detail of the object of interest and the image of which must be obtained is called SOD, and the distance between the X-ray source and the X-ray detector is called SID. If the enlargement ratio, equal to the SID/SOD ratio, is modified without, however, changing the SID, the number of X photons crossing the detail of interest will be modified according to the square of that ratio. Consequently, the amplitude of the quantum noise associated with the number of photons and, therefore, the effective signal-to-noise ratio will be modified, even if the modification of enlargement has no effect on the spatial resolution.

When the change of enlargement is made through a change of SID, the resulting effect on the signal-to-noise ratio will depend on the combination of effects of the change in intensity of the source caused by the modification of SID and enlargement respectively. In all cases, the change of geometries by displacement of the image receptor opposite the object and by displacement of the object in the direction of the source will entail a significant increase in dose received by the object.

BRIEF SUMMARY OF THE INVENTION

The present invention is an apparatus and method making possible a variation of enlargement without increasing the dose received.

The apparatus and method serves to adjust the entrance dose of a radiology apparatus of the type containing a source of radiation of an X-ray beam, a means of detection of the X-ray beam after it has crossed an object having to be visualized, and a means of visualization connected to the means of detection. The distance between the radiation source and the object is estimated and, when the distance between the radiation source and the object or the distance between the radiation source and the means of detection varies, the entrance dose is modified according to these distances in order to maintain an appreciably constant equivalent dose in the plane containing the object, the distance between the radiation source and the means of detection being known.

The present invention will be better understood by studying the detailed specification of some embodiments taken by way of nonlimitative example and illustrated by the attached drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 and 2 are schematic views of radiology apparatuses according to the prior art;

Figure 3 is a schematic view of a radiology apparatus used with a standard table;

Figure 4 is a schematic view of a radiology apparatus used with a moving table; and

Figure 5 is a schematic view of a radiology apparatus iwith C-arms with isocentric movements.

DETAILED DESCRIPTION OF THE INVENTION

As can be seen in Figure 1, the radiology apparatus comprises an X-ray tube 1 capable of emitting an X-ray beam 2. The X-ray tube 1 is supplied by a high-voltage source 3 controlled by a control unit 4. Placed on the path of the X-ray beam 2 are an object 5 having to be studied, for example, a part of a object's body, and a digital type image receptor 6, for example, a solid-state receptor, capable of emitting on output on a line 7 a digital signal representing the image obtained by the image receptor 6, which picks up the X-ray beam after it has crossed the object 5. The line 7 can be connected to image processing means and to display means, such as a screen, not represented.

The radiology apparatus also includes a brightness sensor 8 capable of emitting on the line 9 connected to the control unit 4 a signal representing the brightness of the image obtained. The brightness sensor can be formed by a part of the solid-state detector. The control unit 4 is also connected to a line 10 on which it receives a brightness reference signal in order to make possible a control of the voltage generator 3, so that the brightness level will be kept constant.

In the embodiment of Figure 2, a filter 19 is placed in the X-ray beam exiting from the tube 1. The image receptor 6 includes a radiological image intensifier 21, an iris diaphragm 22 and a video camera 23 placed after the object 5 in the direction of propagation of the X-ray beam. The intensifier 21 carries out the transformation of the X-ray beam into a visible light beam. The diaphragm 22 is controlled by the control unit 4 and makes possible the adjustment of gain. The video camera 23 contains a cell matrix CCD and a dose or level estimator 24 connected to the control unit 4, and supplies on output a signal that is used to visualize the radiological image.

In the present invention, the distance between the X-ray tube and the detail or details of interest in the object is estimated and when the geometry changes, the image receptor entrance dose is changed, taking into account the

SID and the SOD, for the purpose of reducing the variation of equivalent dose in the plane containing the details of interest in the object 5 consecutive to the change of the SID and SOD.

As can be seen in Figure 3, in the case of an imaging system where the tube is placed under the object, the distance between the X-ray tube 1 and the surface 12 of the table top 11 is constant and known. It is considered then that the detail of interest in the object's body is on the average at a constant height above the surface 12 of the table top 11, for example, 10 to 15 cm. That distance can be modified according to the actual examination in progress and a general knowledge of the anatomy, considering, for example, that a vertebra has a height of 5 cm.

The image receptor 6 is mobile perpendicular to the axis of the X-ray beam in the direction illustrated by the arrow 13. The plane 14 perpendicular to the axis of the X-ray beam and in which the details of interest of the object's body are situated is then estimated and the SOD between the X-ray tube 1 and the detail of the object's body is deduced. The SID between the X-ray tube 1 and the image receptor 6 depends on the geometry of the radiology apparatus and is also known. One can then act on the supply parameters of the X-ray tube 1 so as to keep the equivalent dose received in the plane 14 constant, whatever the course of the SID, preferably by using a correction factor corresponding to the ratio between the square of the SOD and the square of the SID.

By way of example, in radioscopy, by taking as reference an SID equal to 1 m and an SOD equal to 0.85 m, with a dose rate at the entrance of the image receptor of 60 µR/s, if the image receptor is away from the object by a distance of 0.25 m, the SID becomes 1.25 m and the SOD remains constant. The SOD^2 / SID^2 ratio passes from value 0.7225 to value 0.4624. The dose rate at the entrance of the image receptor passes from 60 µR/ second to 60 x (0.4624/60 / 0.7225) = 38.4 µR/second. If, for an SID maintained equal to 1 m, the object is moved toward the X-ray tube by 0.15 m, the SOD is equal to 0.7 m and the SOD^2 / SID^2 ratio then passes from 0.7225 to 0.49. The entrance dose rate in the

image receptor then passes from 60 μR/second to 60 x (0.49 / 0.7225) = 40.7 μR/second.

In Figure 4, the case where the image receptor 6 is placed under the table 11 is illustrated, the X-ray tube 1 being placed above the object 5 lying on the table 11. The distance between the image receptor 6 and the upper surface 12 of the table 11 is known and fixed. The detail of interest of the object's body 5 is situated in relation to the upper surface 12 at a distance that is estimated. In that case, the distance between the image receptor 6 and the plane 14 is then determined by estimate. The difference between the SID and the SOD is then known. One further learns the SID between the X-ray tube 1 and the image receptor 6, which depends on the geometry of the radiology apparatus and on the displacement of the X-ray tube 1 in the direction of the arrow 15. Knowing thus the SID and the SID - SOD difference, one can then calculate the SOD and the SOD^2 / SID^2 ratio to be used for correction of the entrance dose in the image receptor 6.

In Figure 5, the case of a radiology apparatus containing a C-arm with isocentric movement is illustrated. This type of radiology apparatus generally contains two or three axes of rotation making it possible to take images at different angles in relation to an immobile geometric isocenter situated in the plane 14 containing the detail of interest of the object's body. In this case, one takes the estimate according to which the detail of interest of the object's body is placed in the isocenter, the geometric position of which, relative to the radiology apparatus, is known. Plane 14 is therefore a plane perpendicular to the axis of propagation 16 of the X-ray beam. The isocenter lies at the intersection of the axis 16 and plane 14.

The table 11 remains horizontal, regardless of the movement of the radiology apparatus, and can be displaced vertically in height in the direction of the arrow 17. The position of the image receptor 6 is fixed in relation to the X-ray tube 1, apart from the fact that it can be displaced in the direction of the arrow 18, that is, along the axis 16 of propagation of the X-rays. The SID is

therefore known, depending on the geometry of the radiology apparatus and displacement of the image receptor 6 along the axis 16. The SOD is known, depending on the geometry of the radiology apparatus, for the distance between the isocenter and the X-ray tube 1 remains constant. In the course of use of the radiology apparatus, the table 11 is displaced in height, so that the detail of the object's body having to be studied is placed in the isocenter or otherwise in immediate proximity to the isocenter.

Advantageously, when the image receptor is an image intensifier and the brightness signal is obtained from the video signal furnished by a video camera placed below the image intensifier in the direction of propagation of the X-rays, and when the optical gain is adjusted by means of a diaphragm placed between the image intensifier and the video camera, the diaphragm opening can be changed in a proportion making it possible to follow in real time variations of the geometric enlargement in a manner conforming to the invention, including an exact compensation by a factor equal to the SOD^2 / SID^2 ratio.

When the detail of interest of the object's body or a material introduced in the object for medical needs has known dimensions or relative dimensions taken in relation to a reference under known particular conditions, it is possible to determine the real enlargement factor in the plane of the detail of interest by image processing means capable of recognizing the object in the images within a time compatible with operation of the automatic brightness control, to measure the dimensions of the object and to calculate the ratio between the reference dimension and the measured dimension.

The invention therefore provides a method and apparatus to reduce significantly the dose received by the object, compared to the previously known methods. It is thus possible to uncouple the geometric aspect of enlargement from the possible improvement of the image supplied by an increase in radiation related to an element of the anatomy.

In an embodiment of the invention, the distance between the radiation source and an interesting detail of the object is estimated.

The entrance dose is advantageously modified according to the ratio of the square of the distance between the radiation source and the object and of the square of the distance between the radiation source and the means of detection.

In an embodiment of the invention, the distance between the radiation source and the object is estimated by approximation of the distance between the object and a table supporting the object, taking into account the object's morphology.

In an embodiment of the invention, the distance between the radiation source and the object is estimated by considering the object to be placed roughly on an axis of rotation of the radiology apparatus.

Advantageously, in case the radiology apparatus includes a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it or any other optical means, such as, for example, a variable attenuation filter, the opening of the diaphragm or optical means is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

In an embodiment of the invention, knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize the object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

Thus, the object's exposure to X-rays is reduced when a high enlargement is used. The use of overly high X-ray parameters is prevented when long source-image receptor distances are used with a sizable enlargement

factor. In particular, one can avoid the use of overly high supply voltages of the X-ray source, which would risk producing a degradation of image contrast.

Various modifications in structure and/or steps and/or function may be made by one skilled in the art without departing from the scope of the invention.

WHAT IS CLAIMED IS:

1. A method of adjustment of the entrance dose of a radiology apparatus of the type containing a means of X-ray beam emission, a means of detection of the X-ray beam after it has crossed an object to be visualized, and a means of visualization connected to the means of detection, in which the distance between the means of emission and the object is estimated and, when the distance between the means of emission and the object or the distance between the means of emission and the means of detection varies, the entrance dose is modified according to said distances in order to maintain an appreciably constant equivalent dose in the plane containing the object, the distance between the means of emission and the means of detection being known.

2. The method according to claim 1, in which the distance between the means of emission and a detail of interest of the object is estimated.

3. The method according to claim 1, in which the entrance dose is modified according to the ratio of the square of the distance between the means of emission and the object and to the square of the distance between the means of emission and the means of detection.

4. The method according to claim 2, in which the entrance dose is modified according to the ratio of the square of the distance between the means of emission and the object and to the square of the distance between the means of emission and the means of detection.

5. The method according to claim 1, in which the distance between the means of emission and the object is estimated by approximation of the distance between the object and a table supporting the object, taking into account the object's morphology.

6. The method according to claim 2, in which the distance between the means of emission and the object is estimated by approximation of the distance between the object and a table supporting the object, taking into account the object's morphology.

7. The method according to claim 3, in which the distance between the means of emission and the object is estimated by approximation of the distance between the object and a table supporting the object, taking into account the object's morphology.

8. The method according to claim 4, in which the distance between the means of emission and the object is estimated by approximation of the distance between the object and a table supporting the object, taking into account the object's morphology.

9. The method according to claim 1, in which the distance between the means of emission and the object is estimated by considering the object to be placed roughly on an axis of rotation of the radiology apparatus.

10. The method according to claim 2, in which the distance between the means of emission and the object is estimated by considering the object to be placed roughly on an axis of rotation of the radiology apparatus.

11. The method according to claim 3, in which the distance between the means of emission and the object is estimated by considering the object to be placed roughly on an axis of rotation of the radiology apparatus.

12. The method according to claim 1, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

13. The method according to claim 2, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

14. The method according to claim 3, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

15. The method according to claim 4, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

16. The method according to claim 5, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

17. The method according to claim 6, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

18. The method according to claim 7, in which the radiology apparatus including a diaphragm situated on an optical path and making it

possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

19. The method according to claim 8, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

20. The method according to claim 9, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

21. The method according to claim 10, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

22. The method according to claim 11, in which the radiology apparatus including a diaphragm situated on an optical path and making it possible to adjust the attenuation of the quantity of light crossing it, the opening of the diaphragm is controlled to regulate the gain, so that an appreciably constant equivalent dose in the plane containing the object is maintained.

23. The method according to claim 1, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images,

the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

24. The method according to claim 2, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

25. The method according to claim 3, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

26. The method according to claim 4, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

27. The method according to claim 5, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

28. The method according to claim 6, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

29. The method according to claim 7, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

30. The method according to claim 8, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

31. The method according to claim 9, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

32. The method according to claim 10, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

33. The method according to claim 11, in which knowing the real size of the object or of a material introduced in the object for medical needs, an image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

34. The method according to claim 12, in which knowing the real size of the object or of a material introduced in the object for medical needs, an

image processing is carried out to recognize said object in the different images, the size of said object is measured and the ratio between the real size and the measured size is calculated in order to deduce its real enlargement factor.

35. Radiology apparatus comprising:

means for emission of an X-ray beam;

means of detection of the X-ray beam after it has crossed an object to be visualized;

means for visualization connected to the means of detection;

wherein a first distance between the means for emission and the object is estimated;

wherein a second distance between the means for emission and the means for detection is known;

wherein when a third distance between the means for emission and the object or a fourth distance between the means for emission and the means for detection varies, an entrance dose of the X-ray beam to the means for detection is modified according to the third or fourth distance to maintain an appreciably constant equivalent dose in a plane containing the object.

METHOD AND APPARATUS CONTROL OF EXPOSURE

IN RADIOLOGICAL IMAGING SYSTEMS

ABSTRACT OF THE DISCLOSURE

Method and apparatus for adjustment of the entrance dose of a radiology apparatus of the type containing a means of X-ray beam emission, a means of detection of the X-ray beam after it has crossed an object having to be visualized, and a means of visualization connected to the means of detection, in which the distance between the means of emission and the object is estimated and, when the distance between the means of emission and the object or the distance between the means of emission and the means of detection varies, the entrance dose is modified according to said distances in order to maintain an appreciably constant equivalent dose in the plane containing the object, the distance between the means of emission and the means of detection being known.

FIG_1

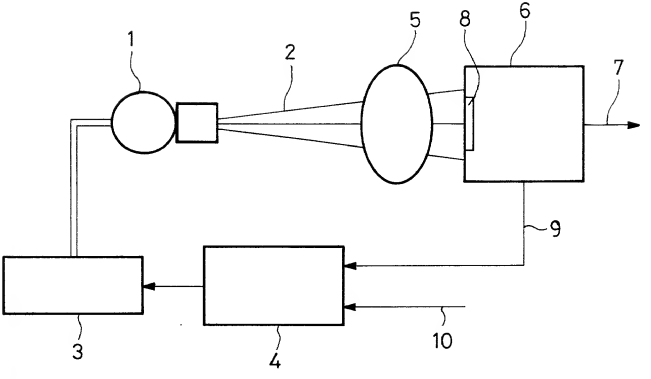


FIG_3

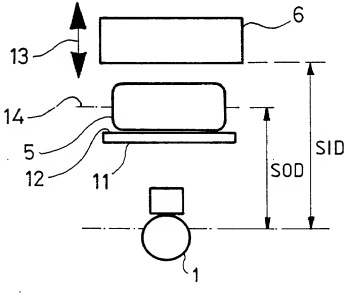


FIG_2

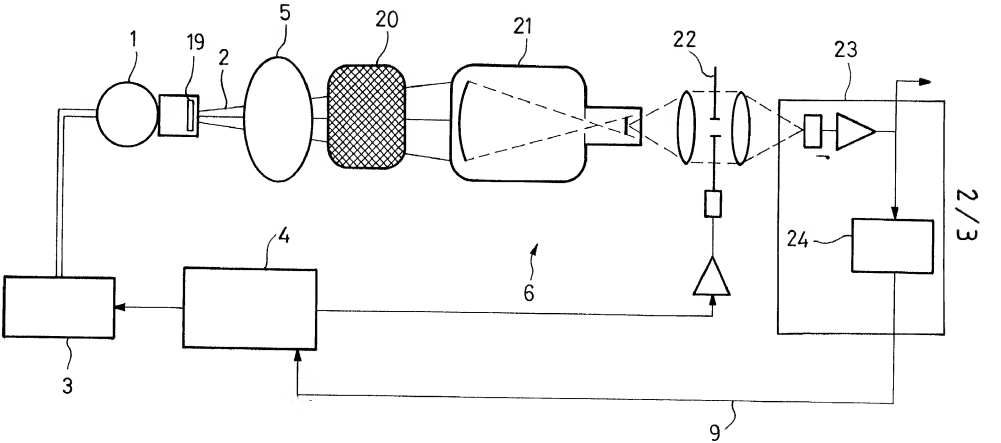


FIG_4

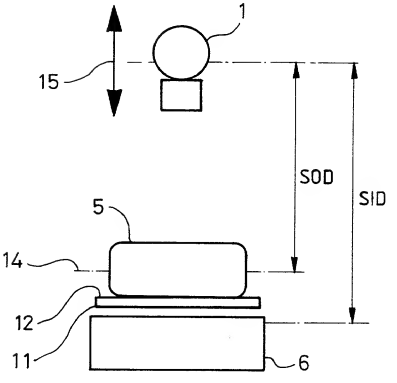
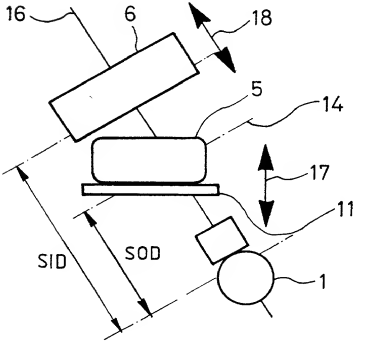


FIG_5



**COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND APPARATUS FOR CONTROL OF
EXPOSURE IN RADIOLOGICAL IMAGING SYSTEMS

☐ the specification of which is attached hereto OR

☐ was filed on as Application Serial No. or PCT International
Application Number and was amended on
(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C.§119(a)-(d) or 365(b) of any foreign application for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 U.S.C. 119
France	99 02711	4 March 1999	☐ Yes ☐ No
			☐ Yes ☐ No

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or 365(c) of any PCT International application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose material information as defined in 37 CFR §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

U.S. PARENT APPLICATION OR PCT PARENT NUMBER	PARENT FILING DATE (day, month, year)	STATUS (patent and number, pending, abandoned)

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s)listed below.

APPLICATION NUMBERS (S)	FILING DATE (day, month, year)

As a named inventor, I hereby appoint Christian G. Cabou (Reg. No. 35,467) and Phyllis Y. Price (Reg. No. 34,234) both of GE Medical Systems, 3000 North Grandview Blvd., Waukesha, Wisconsin 53188; Ronald E. Myrick (Reg. No. 26,315), Henry J. Policinski, (Reg. No. 26,621), and Jay L. Chaskin, (Reg. No. 24,030) all of General Electric Company, 3135 Easton Turnpike, Fairfield, Connecticut 06431-0001 jointly, and each of them severally, my attorneys, with full power of substitution, delegation and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent and to transact all business in the Patent and Trademark Office connected therewith.

I hereby direct that all correspondence and telephone calls in connection with this application be addressed to Jay L. Chaskin, General Electric Company, 3135 Easton Turnpike, Fairfield, Connecticut 06431-0001, telephone number: 203-373-2867, fax number: 203-373-3991.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that all such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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